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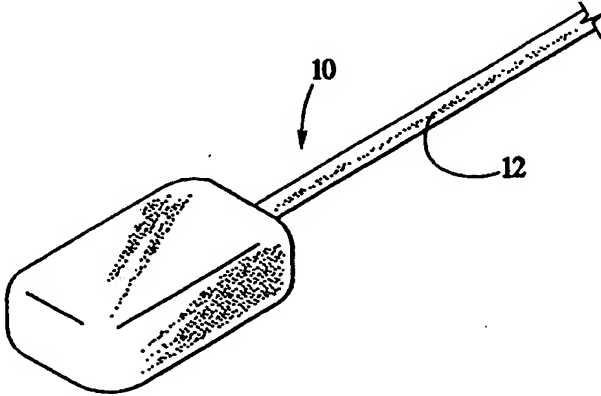
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b>  <b>A61M 29/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/59669</b>  <b>(43) International Publication Date:</b> 25 November 1999 (25.11.99)
<b>(21) International Application Number:</b> PCT/US99/11084  <b>(22) International Filing Date:</b> 18 May 1999 (18.05.99)  <b>(30) Priority Data:</b> 60/085,896                      18 May 1998 (18.05.98)                      US  <b>(71)(72) Applicant and Inventor:</b> BRYAN, Vincent, E., Jr. [US/US]; Suite 110, 9655 S.E. 36th Street, Mercer Island, WA 98040 (US).  <b>(74) Agent:</b> PARKHURST, Todd, S.; Hill & Simpson, Sears Tower, 85th floor, 233 South Wacker Drive, Chicago, IL 60606 (US).		<b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> BALLOON JACK  <div style="text-align: center;">  </div>  <b>(57) Abstract</b>  <p>The invention relates to an inflatable balloon catheter (10) called a balloon jack, which serves to distract vertebral bodies (17, 18) or other anatomical structure at the site of an implant or other surgical procedure. The device is an alternative to a standard intervertebral body separator. It is designed to minimize damage to the cortical endplates during distraction. The balloon jack (10) is fabricated from non-compliant polyethylene terephthalate (PET), commonly used in urology, and cardiology balloon catheters. In addition, the balloon jack (10) may be used to separate other structures including bone at locations throughout the body.</p>		

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## SPECIFICATION

### TITLE:

**“BALLOON JACK”**

### FIELD OF THE INVENTION

5           This utility application claims domestic priority from U.S. Provisional  
Application Serial No. 60/085,896, filed May 18, 1998.

### BACKGROUND OF THE INVENTION

          This invention relates generally to separators for approximated bones,  
and more specifically relates to intervertebral body separators. The invention also  
10       relates to surgical procedures associated with the introduction of the balloon jack  
and the manner in which it is configured to relate to the surfaces upon which the  
jack will act.

          The distraction or separation of vertebral bodies on either side of the disc  
space is undertaken to facilitate a surgical procedure between the two bones which  
15       is best undertaken when the space is enlarged. This applies also to other joints.  
Mechanical means of separating bones, in particular the vertebral bodies, usually  
utilizes firm, usually metal, surfaces which apply a mechanical load to the  
engaged bony surfaces, which in turn facilitates the separation of the two

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interposed surfaces. Often times, however, the surface upon which the mechanical force is exerted is small, and frequently the bone surfaces not configured to the form of the metallic surface acting on it. Consequently, as the distractor force is increased, mechanical disruption of the bony surface occurs  
5 leading to uneven and compromised bone surfaces. This becomes especially important during implant procedures wherein the maintenance of the integrity of the bone surface is essential to the proper performance of the functional implant device to be inserted.

In the past, Cloward and Smith-Robinson popularized anterior surgical  
10 spinal approaches, and, more recently, Ray and others have developed means to distract the intervertebral disc spaces mechanically for the insertion of bone grafts, fusion cages, hydrogel nuclei replacement, etcetera. In every instance, mechanical devices have been utilized, including metallic spreaders, metallic shims, wedges, and, in the case of Kaspar, distracters attached to posts inserted in the  
15 approximating bone. In every instance, bone damage on the surface or in the softer central portion of the bone itself may result if the distraction force on a relatively small area exceeds the inherent strength of the bone at that area.

It is the primary aim of the present invention to provide a means of distraction which will exert the forces required for such distraction over a larger  
20 surface, and in a manner wherein that force can be configured, during the period of distraction, to mate with the bone surface area.

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It is another object to maintain such distraction, once the desired degree of distraction has been achieved without loss of separation over time.

It is another object to be able to introduce the means of distraction, i.e., the balloon, through a very small opening, to inflate it to a much larger size than the entry port, and to remove it through the same small opening without compromising surrounding tissue.

It is yet another object to achieve the pressures within the balloon necessary to fulfill the goal of distraction and have a means of determining what such pressures are at any given time and, thereby, to limit excessive pressures which might cause either failure of the balloon or deformation of the bony surface upon which it is acting.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings. Throughout the drawings, like reference numerals refer to like parts.

15

### **SUMMARY OF THE INVENTION**

To accomplish these objects, the invention compromises an inflatable balloon made of non-compliant polyethylene terephthalate (PET) designed to distribute the force sufficient to provide the distraction in the intervertebral disc space or in whatever joint space it might be placed, such that separation of the opposing bony surfaces will take place as desired, although pressures on the bone will be below pressures that would lead to bony deformation. Thus, the

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relationship of the size of the balloon to the insert space and the deformation pressure factor can be computed for any given joint space, and the balloon sized accordingly. The shape of the balloon is configured in a somewhat rectilinear or cubical fashion, though it is not limited to such. The non-compliant (PET) sides  
5 limit the expansion of the balloon except in those areas of the opposing bones with the sides of the balloon being of such length as to allow the balloon jack to be effective through the desired distraction range.

The stem assembly to the balloon must be of significant thickness to allow the pressure required to perform the distraction and to inflate the balloon to  
10 such pressures to be maintained without deformation of the stem. It is yet another object to provide a method of inserting the balloon jack through a narrow tube such as might be used in microsurgery or endoscopic surgery.

To accomplish these objectives, the invention comprises an inflatable balloon with attached catheter which serves to distract the vertebral bodies at the  
15 site of the implant. The insertable balloon catheter is preferably made of non-compliant polyethylene terephthalate (PET) and is fashioned in its shape and size in accordance with the requirements of load and surface area described above. Once inflated, the predetermined geometric shape conforms to the surrounding bony surfaces. Continued inflation initiates the distraction process to the desired  
20 degree.

To construct the balloon jack for any given application — as for

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specifically the intervertebral disc space — information is obtained regarding the size, shape, and desired distraction of the vertebral bodies for a particular indication and then the balloon is fabricated to provide such distraction within the framework of the load limitations described above — i.e., the compressibility leading to deformation of the surrounding bony surfaces in that area. The length of the stem is determined by the surgical technique, such that the surgeon may inflate the balloon through the stem while the hands are well free of the wound area. It is important that the balloon, prior to insertion, be collapsible, and that its width together with that of the stem be of such size that it can be readily passed through the openings in the various tissue planes as well as through any canulus which may provide access to the desired location.

#### **DETAILED DESCRIPTION**

While initially described in connection with the preferred embodiment and procedure, it will be understood that it is not intended to limit the invention to this embodiment or procedure. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is an isometric view of the novel balloon jack in its deflated condition;

Figure 2 is an isometric view of the novel balloon jack in its inflated



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condition;

Figure 3 is a fragmentary elevational view showing the balloon jack in its inflated, distracting condition between two vertebrae; and

Figure 4 is an isometric view of the enplaced balloon jack; adjacent  
5 vertebrae, the balloon jack stem and a pressure-supplying syringe.

#### **DETAILED DESCRIPTION**

Turning more specifically to the drawings, the deflated balloon jack 10  
(and its attached stem 12) is shown in its inflated form in Figures 2-4 has been  
placed into an intervertebral disc space 20 located between adjacent vertebral  
10 bodies 17 and 18. The balloon jack can be inflated in the intervertebral disc space  
by liquid or gas delivered through a syringe 15 attached to the stem 12. Later, the  
balloon jack may be deflated and removed. Maintenance of the intervertebral disc  
space may be sustained by means of a known retractor (not shown) placed into the  
intervertebral disc space, the blades of which straddle the inflated balloon before  
15 inflation, thereby allowing distraction to be mechanically maintained following  
removal of the deflated balloon jack.

To encourage maximal distraction with minimal load applied to any  
given segment of the opposing bones, it is the intention of the design of the  
balloon jack to occupy the maximum area available between the opposing bones  
20 so as to spread the force over the maximum area, thereby decreasing bone  
deformation. It should be noted that the surface of the deflated balloon 10, when

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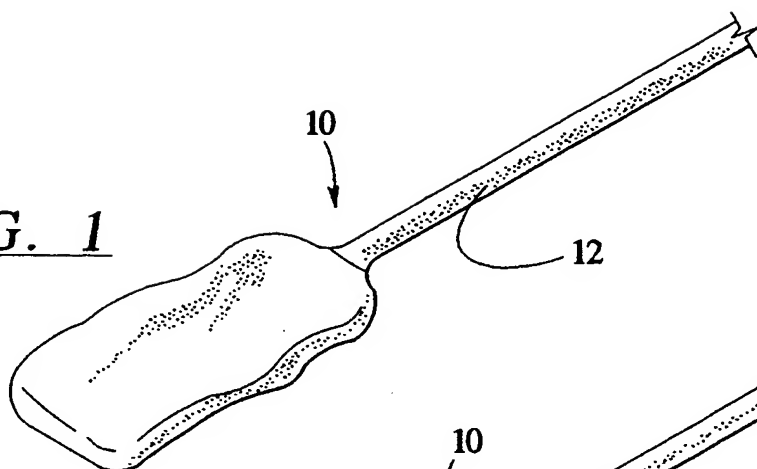
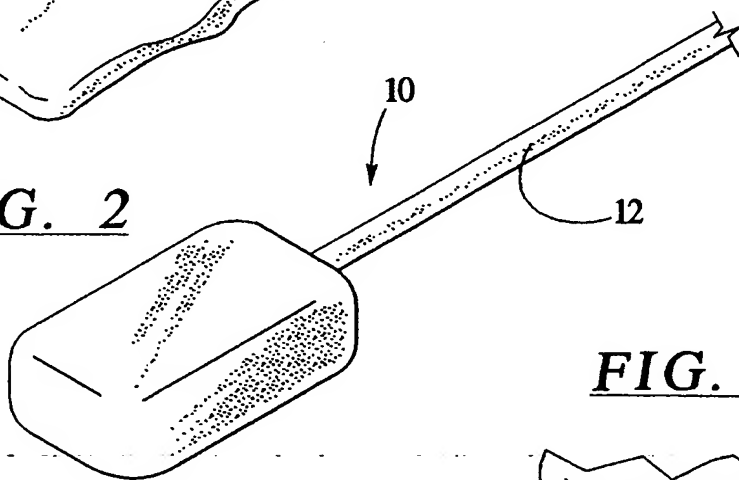
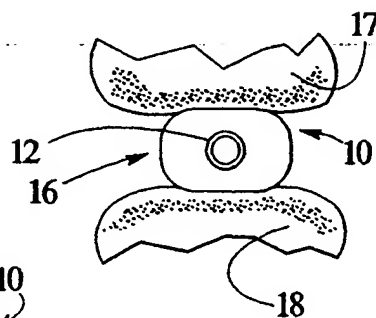
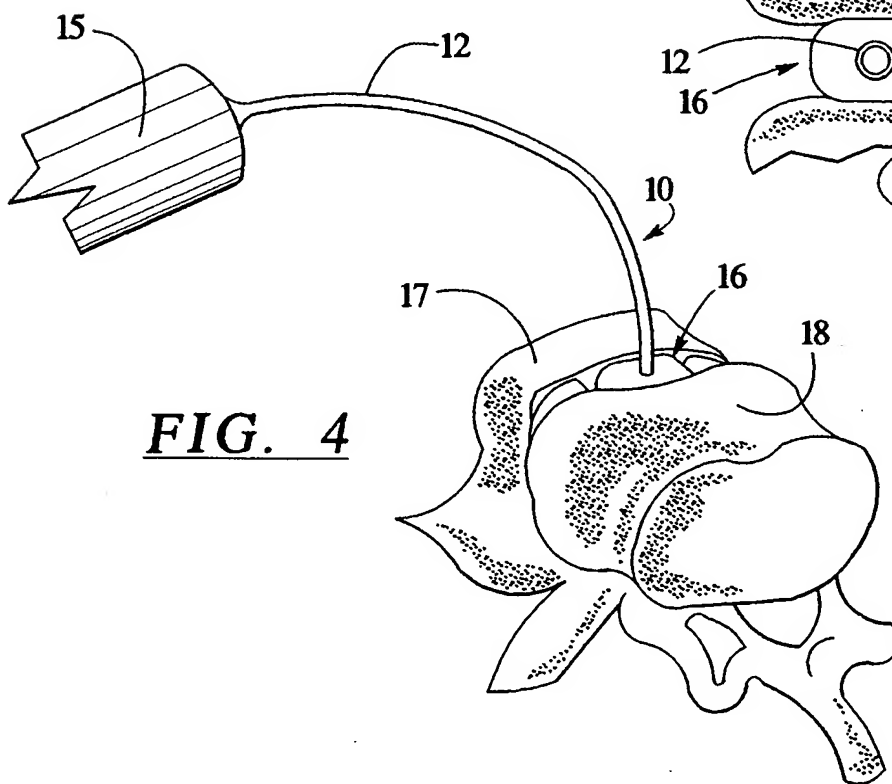
expanded as shown in Figures 2-4, by the injection of a fluid from the syringe 15 through the stem 12, can, by the properties of the material, conform when under load to the anatomical shape of the opposing bony surfaces.

Though the material described in the description (PET) is essentially  
5 non-expansile, any other polymeric material possessing similar properties may be utilized in the manufacture of the balloon.

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**Claims:**

1. An inflatable balloon catheter jack which serves as a jack  
when inflated to distract opposing bones in a joint space, the balloon jack being  
configurable as to size and shape such that the forces required to separate the  
5 opposing bones can be spread over a large surface area of the opposing bones  
when expanded to achieve the desired degree of expansion without causing  
damage or deformation to the opposing bone surfaces.
2. An inflatable balloon catheter jack according to Claim 1,  
wherein said balloon is fabricated from non-compliant polyethylene terephthalate  
10 (PET) material which may be collapsed or expanded to a predetermined size and  
shape.
3. An inflatable balloon catheter jack according to Claim 1,  
further including a stem attached to a syringe or other pressurizing system, the  
stem providing for the introduction of a fluid or gas to expand said balloon for  
15 purposes of distracting two opposing bony surfaces.
4. An inflatable balloon catheter according to Claim 1, wherein  
the inflated balloon has a rectilinear shape similar in shape and size available to  
the surgical area after the balloon has been surgically entered so as to allow  
maximum bony surface bearing of the applied distraction force over the greatest  
20 available area to accomplish distraction without bony deformation.

FIG. 1FIG. 2FIG. 3FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/11084

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :A61M 29/00

US CL :604/96

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 604/96, 97, 98; 606/192

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,021,043 A (BECKER et al) 04 June 1991, col. 6 lines 46-55.	1-4
X	US 5,169,386 A (BECKER et al) 08 December 1992, entire document.	1-4
X	US 5,645,560 A (CROCKER et al) 08 July 1997, col. 7 lines 46-59.	1-4
X, P	US 5,843,116 A (CROCKER et al) 01 December 1998, entire document.	1-4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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